Design of 'SoftlinkToTclTk.sh'

Programming Language Used

The programming language used is 'bash', the Unix/Linux shell language. It was chosen because it is universally available on all Linux computers, and contains all the functionality required to accomplish the required task.

Consequently the program to create the softlinks is a bash script, and hence has the extension 'sh' to its name.

Tasks Performed by the Script

1. Search for the 'Tcl' and 'Tk' Runtime Libraries, to find their full names (including version numbers) and the paths to them.
2. Validate the libraries found to ensure that :
   - at least one 'Tcl' library and one 'Tk' library is found;
   - for every 'Tcl' library found, there is a 'Tk' library with the same version number.
3. Create a softlink to each of the relevant 'Tcl' and 'Tk' libraries.

1. Search for the 'Tcl' and 'Tk' Libraries

The first task is to discover which 'Tcl' and 'Tk' runtime libraries (if any) are already installed on the computer. (The 'Tcl' and 'Tk' runtime libraries are shared object libraries, i.e. dynamic link libraries or DLLs). To do this requires understanding the arrangement for storing such libraries on Linux.

The list of directories in which shared object libraries are located is stored in the file **/etc/ld.so.conf**. Since searching through this would be very inefficient , a caching arrangement is used.

> "*The program **ldconfig** by default reads in the file **/etc/ld.so.conf,** sets up the appropriate symbolic links in the dynamic link directories (so they'll follow the standard conventions), and then writes a cache to **/etc/ld.so.cache** that's then used by other programs. This greatly speeds up access to libraries. The implication is that **ldconfig** must be run whenever a DLL is added, when a DLL is removed, or when the set of DLL directories changes; running **ldconfig** is often one of the steps performed by package managers when installing a library. On start-up, then, the dynamic loader actually uses the file **/etc/ld.so.cache** and then loads the libraries it needs.*[1]"

Thus a good way to search for the 'Tcl' and 'Tk' runtime libraries is to search **/etc/ld.so.cache**. This can be done by using ***ldconfig*** with the '-p' parameter, which outputs the contents of the cache. Hence it is first confirmed that ***ldconfig*** is indeed installed on the system.

'***ldconfig*** -p' is used twice. First its output is passed through **grep** with a regular expression to pick out 'Tcl' libraries, and then again through **grep** with a regular expression to pick out 'Tk' libraries. The 2 final outputs are the bash variables *libtcl*

[1] Quote from section 3.2 of the "Program Library HOWTO" document (which discusses the creation and usage of program libraries on Linux) at http://tldp.org/HOWTO/Program-Library-HOWTO/index.html .

and *libtk* respectively. Each variable consists of a line per library, where the line has the format illustrated by the following 2 examples :

libtcl8.6.so (libc6,x86-64) => /usr/lib/x86_64-linux-gnu/libtcl8.6.so
libtcl8.5.so (libc6,x86-64) => /usr/local/lib/libtcl8.5.so

2. Validation of the ‘Tcl’ and ‘Tk’ Libraries Found

Validation needs to check the following :

A. at least one or more copies of both libraries have been found;
B. for every 'Tcl' library found, there is a 'Tk' library with the same version number.

(N.B. 'Tcl' may be installed on its own, but 'Tk' uses 'Tcl' and must be the same version as 'Tcl' to ensure it will run properly on 'Tcl').

Check A is carried out by checking whether *libtcl* and *libtk* are empty, i.e. contain no value, thereby indicating that no corresponding library was found. If either or both are empty, the script gives the user an explanatory error message and exits.

Check B is carried out as part of the softlink creation process.

3. Creation of the Softlinks to the Libraries

The function **createSoftlinks** is provided in the script, and used to carry out the actual creation of softlinks. When it is called, it creates a softlink to the'Tcl' library and another to the 'Tk' library, using the Linux **ln** command. It also uses the Linux **ls** command to output a message to the installer displaying the 2 softlinks created.

Two associative arrays, *tclLibs* and *tkLibs*, are created from the bash variables *libtcl* and *libtk* respectively. Each line in the latter is used via the regular expression comparison operator ‘=~’ to create a corresponding array element in the former.

The text following ‘=>’ is extracted from a file line. This forms an array element’s value. From that value, the version number is extracted to form the array element’s key. If an error arises during this process, the script gives the user an error message and exits.

Two indexed arrays, *keyTcl* and *keyTk*, are created from the associative arrays, *tclLibs* and *tkLibs* respectively. The value of each indexed array element is a version number, i.e. a key value from the associative array.

keyTcl and *keyTk* are sorted to put the version numbers they hold in ascending order.

keyTcl and *keyTk* are then iterated through to pick out the version numbers that occur in both of them, these common version numbers being stored in the indexed array *Common*. The algorithm used for this is as follows :

Create *Tcli* and *Tki* as indexes into *keyTcl* and *keyTk* respectively; set them to index the first array element.

Create the empty indexed array *Common*.

While ((*Tcli* ≤ **Size**(*keyTcl*)) **And** (*Tki* ≤ **Size**(*keyTk*))
{
IF *keyTcl*[*Tcli*] = *keyTk*[*Tki*]
THEN { Append value *keyTcl*[*Tcli*] to *Common* ; *Tcli* += 1 ; *Tki* += 1 }
ELSE IF *keyTcl*[*Tcli*] < *keyTk*[*Tki*]
THEN *Tcli* += 1
ELSE *Tki* += 1
}

If *Common* is empty, the user is given the error message that the ‘Tcl’ and ‘Tk’ installations have no version numbers in common, and the script exits.

If *Common* contains one version number, the softlinks to that installation of ‘Tcl’ and ‘Tk’ are created using **createSoftlinks**, the user is informed, and the script exits.

If *Common* contains more than one version number, the user is asked to choose the installation of ‘Tcl’ and ‘Tk’ they require. The softlinks are created as follows :

1. Output the version numbers from *Common* (so they are in ascending order), prefixed by ID numbers that are the index numbers into *Common*.
2. The installer inputs the ID number of the chosen version, or quits if they do not want to choose one. (If an invalid version number or other value is input, the installer is prompted again for their choice).
3. Softlinks to the selected version of the ‘Tcl’ and ‘Tk’ libraries are created using **createSoftlinks**, and the user informed appropriately.